Contents

Section 9

Southeast Colorado River Basin

Water Planning and Development

9.1 INTRODUCTION

This section of the Southeast Colorado River Basin Plan presents data and information on the planning and development of existing water supplies along with a brief discussion of past and current water development projects. Water demand is projected for the years 2020 and 2050 for domestic, municipal, commercial, industrial, agricultural, recreational and environmental use.

The existing water supplies are vital to the existence of the local communities while also providing environmental and aesthetic values. Local, state and federal agencies as well as other interested parties need to coordinate their activities regarding water resources.

One goal of the Division of Water Resources is to coordinate with federal and other state agencies to provide effective water-related activities and programs at the request of the local people. The decision-making process is the responsibility of the local stakeholders. This plan provides data to help solve existing water problems and for future implementation of the most viable alternatives.

9.2 BACKGROUND

Water has always been an essential part of the cultural and economic growth dating back to the early Anasazi Basketmakers' and Pueblos' diversion of small streams to irrigate their crops. Indian agriculture has waned over the years.

Beginning in the mid-1800s and into the twentieth century, Anglo-Saxon settlers developed relatively large acreages of agricultural crops sustained by diversions from the streams and springs tributary to both the Colorado and San Juan rivers. The growth of cattle oriented agriculture and the discovery of oil and various minerals changed the demand for water. As more people migrated to the area, there were increasing demands for additional water to supply the expanding residential developments and the growth of commercial and industrial businesses associated with tourism, mining of uranium and various precious metals, oil, and other minerals. Although farming and ranching still use most of the water, diversions for agriculture have leveled off because further development is not currently feasible.

> Explosive growth in tourism and recreation has increased the demand for culinary water; at the height of the season it is greater than the needs of the permanent population in some areas. Water development opportunities are being explored for other areas and uses.

9.2.1 Past Water Planning and Development

The Southeast Colorado River Basin has been one of the most sparsely populated areas of the state, mostly because of the limited water supply. Beginning with the aborted Elk

Mountain Mission in 1855, water development has required a long, almost overwhelming but necessary commitment of the settlers' resources. Early use was made of readily available materials to deliver water to their homes and farms as was evidenced by the earth and brush dams used to divert Mill Creek and Pack Creek. By the turn of the century, a larger, more efficient log diversion structure was built by Orlando Warner in upper Spanish Valley. This dam diverted water for a saw mill, flour mill and for irrigation of crops. It was later raised and became part of Moab Light and Power Company.

When the "Hole in the Rock" expedition settled Bluff in 1880, they built riprap diversions and canals to get water from the San Juan River to their crops. The same year, some of them moved on to their original destination at Montezuma Creek where they constructed a waterwheel to divert water from the San Juan River to irrigate their crops. In 1884, floods raised havoc with the irrigation systems in both Montezuma Creek and Bluff.[46]

In 1887, settlers moved to the north and diverted North Creek into the Monticello area and formed what is now the Blue Mountain Irrigation Company. Later, some of the Bluff settlers moved on to the White Mesa and started construction of a ditch to bring water from Johnson Creek to "The Park" above the present community of Blanding.[50] Later a tunnel was constructed to divert water from Indian Creek to Johnson Creek. This 30-year project was finally completed in 1952.[103]

Until the late 1950s, water demands for domestic uses were met by surface water flows and groundwater sources. However, the steady increase in demand has required suppliers to construct various projects to develop supplemental water. The largest of these organizations were the Grand County and San Juan Water Conservancy Districts. Both districts have been major water providers for about 35 years and have sponsored, or been directly involved with, a number of water development projects including the Mill Creek (Ken's Lake-1981), Recapture Creek-1984, and Monticello (Loyd's Lake-1985) projects.

A reservoir was proposed on upper Mill Creek as early as 1909. After several investigations over the years, the Grand County Water Conservancy District constructed a tunnel, diversion dam and a reservoir (Ken's Lake) with a storage capacity of 2,820 acre-feet to serve Spanish Valley.

Loyd's Lake

Investigations by the San Juan Water Conservancy District resulted in a storage reservoir on Recapture Creek to store water from several drainages. The 9,320 acre-foot Recapture Creek Reservoir was built in 1984 to serve 2,000 acres of land in the Blanding area.

A growing demand for culinary water and an extended drought prompted the San Juan Water Conservancy District to study options for additional water supplies. As a result, the district and the City of Monticello constructed Loyd's Lake to provide 500 acre-feet of culinary water and 1,400 acre-feet of irrigation water to the city and the surrounding area.

In anticipation of a growing population, the Town of Bluff decided to upgrade their culinary water system. They drilled three new wells, constructed a 200,000-gallon water storage tank and upgraded the distribution system.

Assistance for these projects as well as for many others was obtained from the Division of Water Resources. A summary of Division of Water Resources assisted water projects is given in Table 9-1. The locations of these projects are shown by project sponsor on Figure 9-1.

Table 9-1
BOARD OF WATER RESOURCES DEVELOPMENT PROJECTS

County/Sponsor	Fund	Type	Year
Grand			
Grand County WCD	C&D	Dam-Reservoir	1979
Moab City	CWL	Culinary system-pipeline	1993
Moab Irrigation Company	RCF	Low head pipeline	1964
Moab Irrigation Company	RCF	Dual water system	1995
Spanish Valley WID	CWL	Culinary system-pipeline	1980
Thompson WID	RCF	Culinary system-tank	1974
Thompson WID	RCF	Culinary system-pipeline	1985
Total - Grand County	**7**		
San Juan			
Blanding City	CWL	Culinary system pipeline	1982
Blanding Irrigation Co	RCF	Tunnel	1948
Blanding Irrigation Co	RCF	Dam-storage reservoir	1962
Blanding Irrigation Co	RCF	Canal	1965
Blanding Irrigation Co	RCF	Pressure pipeline	1968
Blanding Irrigation Co	RCF	Pressure pipeline	1987
Blanding Irrigation Co	RCF	Sprinkler system	1994
Blue Mountain Irr Co	RCF	Sprinkler system	1987
Carlisle Water Co	RCF	Reservoir dam repair	1986
Carlisle Water Co	RCF	Reservoir dam enlargement	1995
Monticello City	CWL	Culinary treatment plant	1976
Monticello City	CWL	Culinary system pipeline	1979
Monticello City	C&D	Culinary treatment plant	1997
San Juan SA #1	RCF	Culinary system	1975
San Juan WCD	C&D	Dam-storage reservoir	1981
San Juan WCD	C&D	Dam-storage reservoir	1984
San Juan WCD	RCF	Reservoir dam repair	1997
Total - San Juan County	**17**		

C&D - Construction and Development Fund
CWL - Cities Water Loan Fund
RCF - Revolving Construction Fund

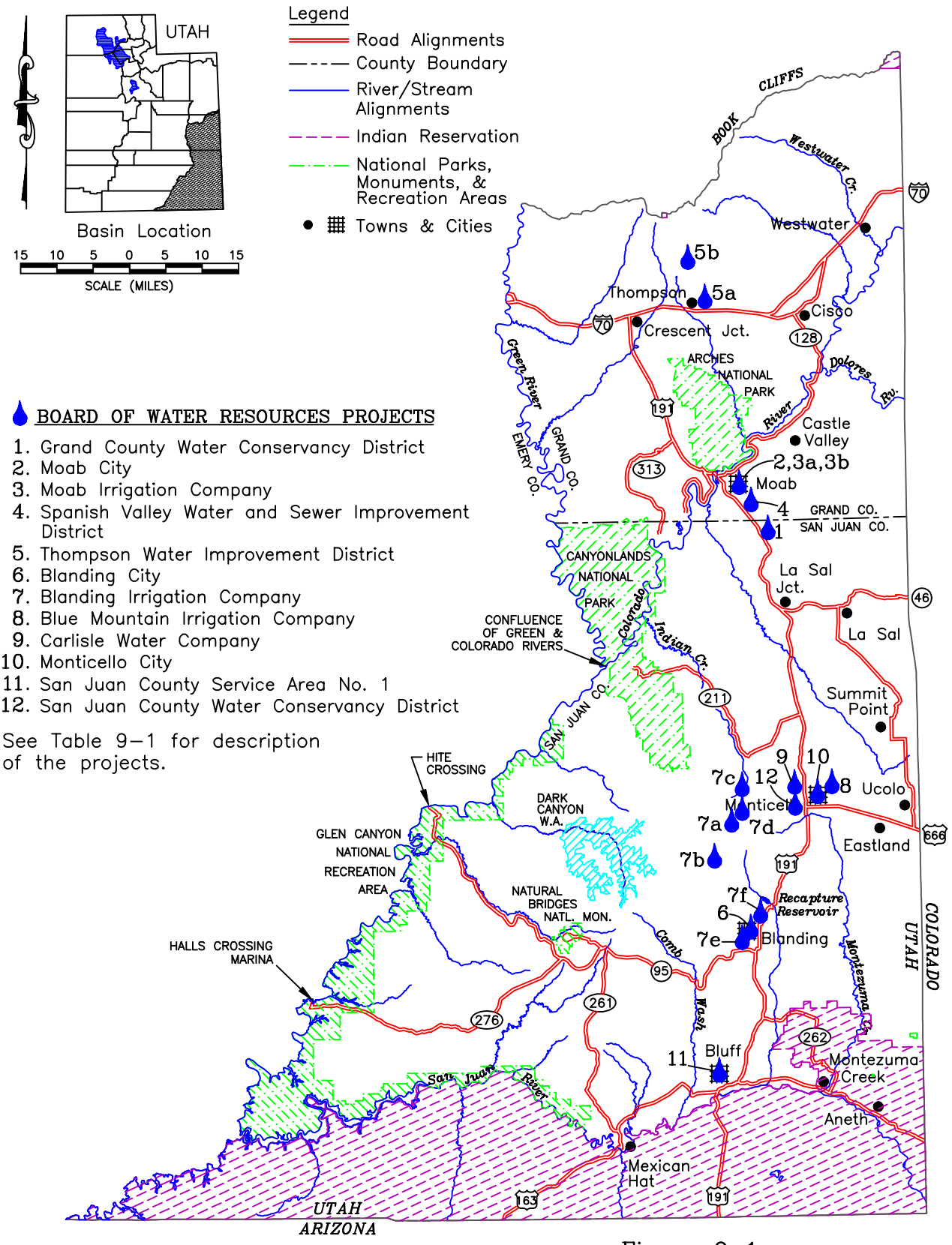


Figure 9–1
BOARD OF WATER RESOURCES PROJECTS
Southeast Colorado River Basin

9.2.2 Current Water Planning and Development

Most of the surface water supplies have been developed. New water for agriculture is not economically feasible unless it can be included in a multiple-use project. For this reason, most of the current planning is to develop municipal and industrial water supplies for the growing community needs within the next 10-20 years and beyond, primarily in Moab, Monticello, Blanding, Bluff and Mexican Hat. There is also planning for culinary water projects on the Navajo Indian Reservation.

To address the need for municipal and industrial water, the Grand County Planning Commission, Moab City and the Grand Water and Sewer Service Agency are preparing plans for long-range development. They are in the process of determining both water supply and infrastructure needs in the Moab and Spanish Valley areas. The San Juan Water Conservancy District completed a master water plan in 1998 prepared by a consulting engineering firm.[96] This plan emphasizes the future demands and discusses alternative ways to meet these needs. More detail on these and other alternatives for meeting future demands are discussed in Section 9.4.

9.3 WATER USE AND PROJECTED DEMAND

The increasing demands for municipal and industrial (M&I) water will require development of new water and the transfer of water from other uses. Population growth estimates given in Section 4, Demographics and Economic Future, are used to project the municipal water demands. The industrial water demands are based on anticipated industrial growth, not population increases. Agricultural water uses will stay about the same but a small amount of the existing supplies may be reallocated to meet M&I demands, particularly in the Spanish Valley/Moab area.

There are a number of local mining operations that could make demands on local surface and groundwater supplies. The level of demand will be dependent on the ever changing economics of the industry itself.

9.3.1 Present and Projected Municipal and Industrial Water [14,15]

The total municipal and industrial (M&I) culinary water use was 5,570 acre-feet in 1996, 3,090 acre-feet in Grand County and 2,480 acre-feet in San Juan County. Of this amount only 30 acre-feet was used for industrial purposes, all in San Juan County.

Total M&I culinary water use is estimated to be 11,140 acre-feet by the year 2020 and 27,980 acre-feet by 2050. This is based on the projected population growth for the same period. Also, no reduction in use is included for any conservation programs. See Table 9-2 for current and projected culinary water use.

Monticello municipal water storage reservoir

In addition, 2,030 acre-feet of self-supplied industrial water was diverted in 1996 with 1,770 acre-feet depleted. Of this amount, 940 acre-feet was diverted in Grand County and 1,090 acre-feet was diverted in San Juan County. Total self-supplied industrial diversions are estimated at 4,560 acre-feet by 2020 and 6,720 acre-feet by 2050. These projections could vary considerably depending on the market for industrial products. See Table 18-1 for more information.

Table 9-2
CURRENT AND PROJECTED CULINARY M&I WATER DEMAND

Year/Use Category	County: Grand	San Juan (acre-feet)	Total
1996			
Residential	2,450	1,970	4,420
Commercial	460	270	730
Institutional	180	210	390
Industrial	0	30	30
Total	**3,090**	**2,480**	**5,570**
Per Capita Use	**319**	**168**	**228**
2020			
Residential	6,210	2,610	8,820
Commercial	1,180	360	1,540
Institutional	460	280	740
Industrial	0	40	40
Total	**7,850**	**3,290**	**11,140**
2050			
Residential	18,450	3,710	22,160
Commercial	3,480	520	4,010
Institutional	1,360	390	1,750
Industrial	0	60	60
Total	**23,290**	**4,680**	**27,980**

9.3.2 Current and Projected Secondary Water[14,15]

Secondary water systems provide irrigation water for residential and municipal areas. This water is also used for other miscellaneous outside uses. Current secondary water use within areas served by public community systems is 1,140 acre-feet, 700 acre-feet in Grand County and 440 acre-feet in San Juan County.

Secondary systems allow the use of lower quality water for irrigation of gardens, parks, golf courses and other large grass areas. This will save water meeting culinary standards for drinking and other related-water uses. The current and projected secondary water uses and demands are shown in Table 9-3.

9.3.3 Agricultural Water Demand[12]

Irrigated agriculture has been established in areas where adequate water supplies have been developed and where fertile soil conditions exist. These areas are primarily located within the Spanish Valley near Moab, in the areas around Monticello and Blanding, and along the flood plain lands near the San Juan River. Over 90 percent of the irrigated agriculture provides feed and forage for the livestock industry and consists of a variety of row and forage crops in addition to pasture lands. Orchards and vineyards are also important crops covering about 250 acres.

The growth of irrigated agriculture has leveled off in most areas but has declined in the Spanish Valley area, primarily due to the encroachment of residential development. The annual rate of

Table 9-3
CURRENT AND PROJECTED SECONDARY M&I WATER DEMAND

Year/Use Category	County		
	Grand	San Juan	Total
		(acre-feet)	
1996			
Residential	120	260	380
Commercial	0	0	0
Institutional	580	180	760
Industrial[a]	0	0	0
Total	**700**	**440**	**1,140**
Per Capita Use	**72**	**30**	**59**
2020			
Residential	310	360	670
Commercial	0	0	0
Institutional	1,430	250	1,680
Industrial	0	0	0
Total	**1,740**	**610**	**2,350**
2050			
Residential	910	510	1,420
Commercial	0	0	0
Institutional	3,830	360	4,190
Industrial	0	0	0
Total	**4,740**	**870**	**5,610**

[a] Does not include self-supplied industrial water.

land lost to home construction is estimated at 10 to 15 acres per year. The net effect of this trend toward urbanization will slightly reduce the demand for water by irrigated agriculture. The overall impact on water demand is expected to be minimal.

The current annual diversions for irrigated agriculture are estimated at 34,950 acre-feet: 13,800 acre-feet for Grand County and 21,150 acre-feet for San Juan County. Also see Table 10-2. This use is expected to remain about the same although conversion of irrigated cropland to residential areas in Spanish Valley would reduce agricultural water diversions by as much as 1,900 acre-feet by 2020 and 4,300 acre-feet by 2050. The reduction in diversion for Grand County is based on conversion of 15 acres per year from agriculture to urbanization and a diversion rate of five acre-feet per acre. Present and projected agricultural water use is shown in Table 9-4.

Sprinkler near Blanding

Table 9-4
CURRENT AND PROJECTED AGRICULTURAL WATER USE (acre-feet)

County	1996		2020		2050	
	Diversions	Depletions	Diversions	Depletions	Diversions	Depletions
Grand	13,800	6,910	11,890	5,950	9,500	4,750
San Juan	21,150	11,520	21,150	11,520	21,150	11,520
Total	34,950	18,430	33,040	17,470	30,650	16,270

9.3.4 Recreational Water Demand

The area in and around the Southeast Colorado River Basin has a number of exceptional recreational opportunities. However, few of these recreational sites use a significant amount of water. Local reservoirs support a limited amount of boating. Camping activities use small amounts of water. As a result, water consumption that can be associated with outdoor recreation is negligible.

9.3.5 Environmental Water Uses

Environmental water use is generally associated with the maintenance of minimum instream flows, wet and open areas including waterfowl refuges, and flows required to maintain water quality in a given stream or river system. The most dominant environmental water use is the maintenance of wetlands and open water areas. There is only one instream flow requirement and that is for a 3-cfs minimum flow below the Sheley Tunnel diversion on Mill Creek.

9.3.6 Water Use Summary

All current water use and the projected demands are based on available data. The current irrigation water use is based on diversion records where they are available. In some cases where records were not available, diversions were estimated based on consumptive use of crops inventoried during the land use surveys. Municipal and industrial uses were inventoried and data shown is for 1996. The current and projected demands are shown in Table 9-5 and on Figure 9-2a, 9-2b and 9-2c for 1996, 2020 and 2050.

The industrial water use represents only a small portion of the total basin diversions. Future industrial use may not increase proportionately with the projected population as new industries are established or eliminated or scaled down as demand for products decreases.

9.4 ALTERNATIVES TO MEET WATER NEEDS

The severe drought years of the mid-to-late 1970s renewed the realization of the significant impact extended water shortages have on the personal lives and economic well being of the region. The water shortages in Grand and San Juan counties during these years were severe and caused the loss of livestock and crops and resulted in the implementation of extreme water conservation measures.

Although surface water is still available, most of it is found in areas where development is not economically feasible at this time. Creeks flowing from the Abajo and La Sal mountains provide most of the developed water supplies although there is still some undeveloped surface water. The groundwater aquifers covering most of the basin are also a major water source with supplies coming from springs, seeps and

withdrawals from wells. Some groundwater has been developed but there is still a considerable amount available.

To provide a source of supplemental water for future drought conditions, the Board of Water Resources provided funding and technical assistance to local water provider agencies to construct several water storage and distribution facilities. These included the Mill Creek, Loyd's Lake and Recapture Creek Reservoir projects. However, population growth in recent years continues to encroach upon available reserves. To address this problem, local water planners have started investigations of other means to provide additional water.

9.4.1 North Creek Development

Preliminary investigations by the Division of Water Resources indicate that up to 1,200 acre-feet of supplemental M&I water could be developed through the construction of a dam and reservoir within the lower North Creek drainage. The cost for a proposed dam and reservoir is estimated at $5.0 million. A second option for developing North Creek water includes construction of a diversion facility with a gravity flow pipeline to the existing Loyd's Lake on South Creek. Loyd's Lake currently has an estimated 1,800 acre-feet excess storage capacity and would be able to store the 1,200 acre-feet from North Creek during an average water year. The cost for the 3- mile pipeline option is estimated at $400,000 not including the cost of rights-of-way.

The development of North Creek water would increase the culinary water supply to provide for the estimated 30 percent increase in population and could provide secondary and some agricultural water.

9.4.2 Dry Wash No. 2 Dam Enlargement

The Dry Wash No. 2 Dam is located on the south slope of the Abajo Mountains in Harris Hollow on the Johnson Creek drainage. The existing reservoir has a capacity of 185 acre-feet and supplies water for irrigation in the Blanding area. The present dam is 43 feet high and 650 feet long. The outlet works consists of

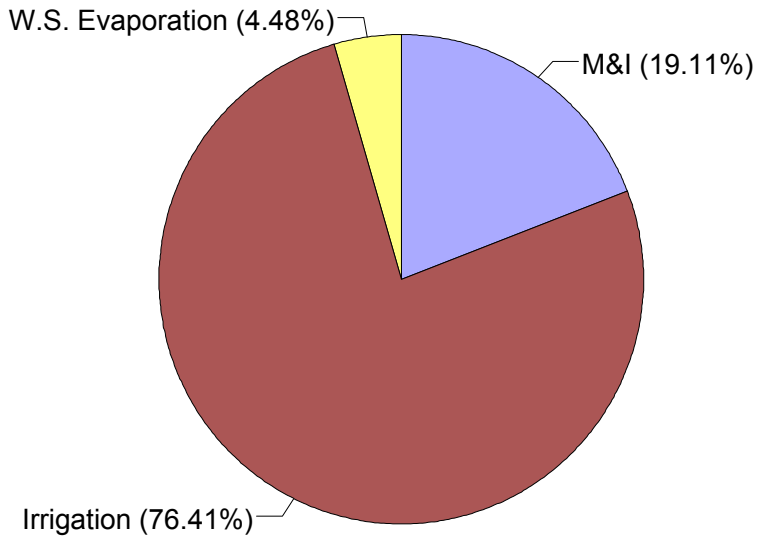
Table 9-5
SUMMARY OF CURRENT AND PROJECTED WATER DEMANDS (acre-feet)

Use	1996		2020		2050	
	Diversions	Depletions	Diversions	Depletions	Diversions	Depletions
Culinary	5,570[a]	3,230	11,140	6,460	27,980	16,230
Secondary	1,140	990	2,350	2,040	5,610	4,880
Industrial[b]	2,030	1,770	4,560	3,970	6,720	5,850
Total M&I	**8,740**	**5,990**	**18,050**	**12,470**	**40,310**	**26,960**
Irrigation[c]	34,950	18,430	33,040	17,470	30,650	16,270
W.S. Evap.[d]	2,050	2,050	2,050	2,050	2,050	2,050
Basin Total	**45,740**	**26,470**	**53,140**	**31,990**	**73,010**	**45,280**

[a] Includes 30 acre-feet of industrial water use.
[b] Self-supplied industrial use. Some industrial use data not available.
[c] Some 1996 data estimated.
[d] Net evaporation, does not include precipitation. Includes cropland areas only.

Figure 9-2a

Water Diversions - 1996



Water Depletions - 1996

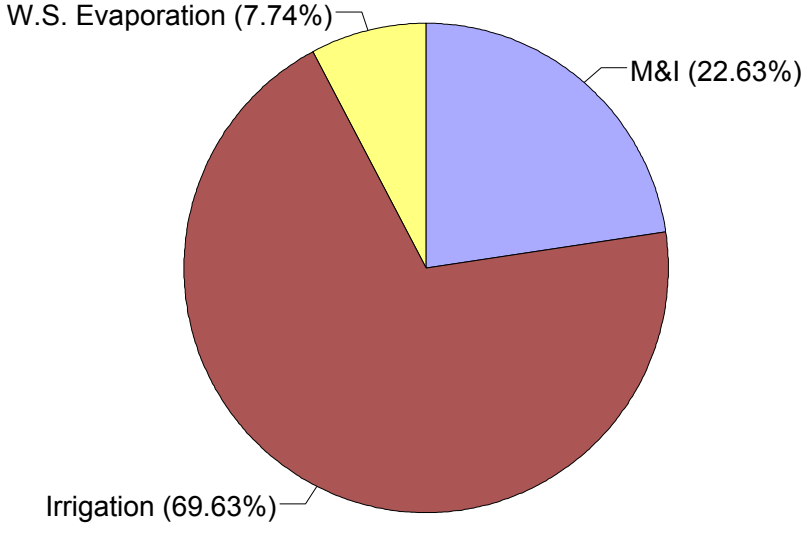
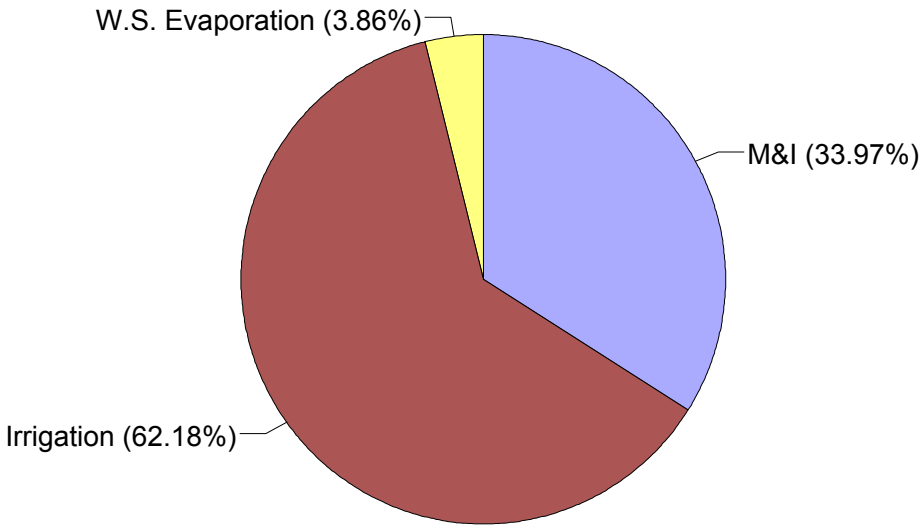


Figure 9-2b

Water Diversions - 2020



Water Depletions - 2020

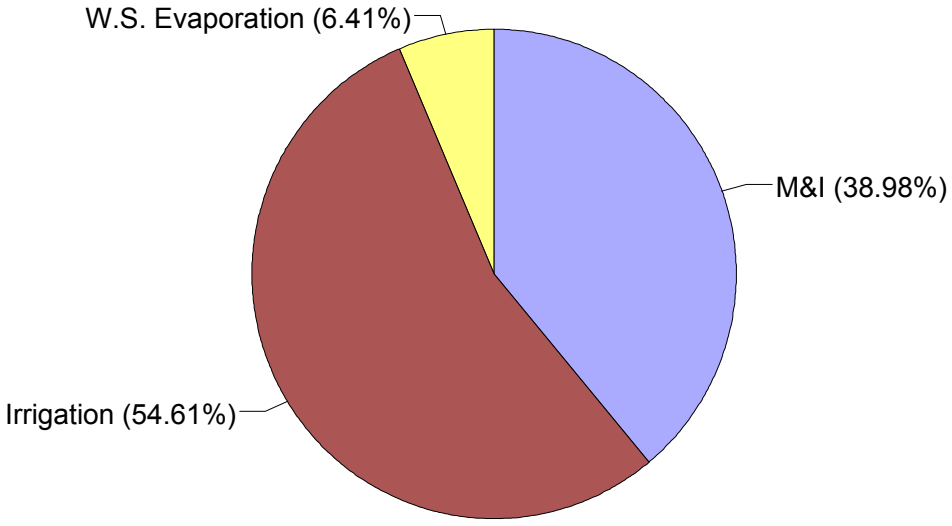
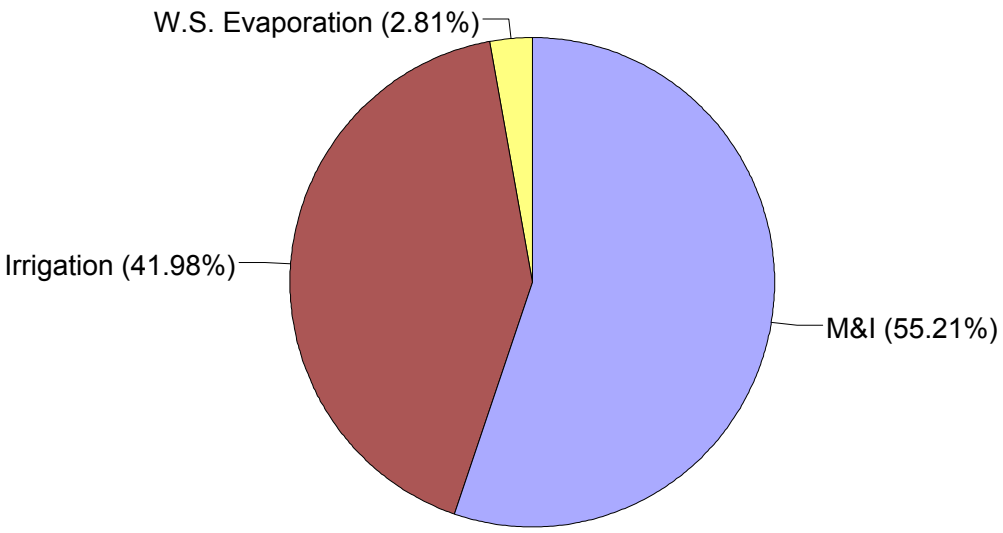
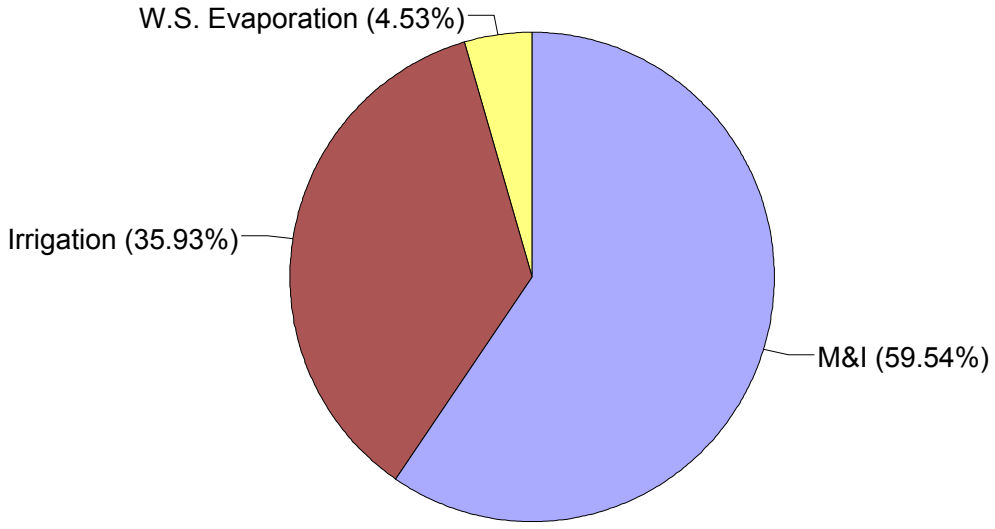


Figure 9-2c

Water Diversions - 2050



Water Depletions - 2050



Dry Wash Reservoir

an 18-inch diameter reinforced concrete pipe and drop inlet overflow (trickle tube) principal spillway. A concrete weir and riprap armored emergency spillway is located left of the embankment.

There has been consideration of raising the dam 12 feet which would double the storage capacity to about 370 acre-feet. The dam can be enlarged by relining the existing outlet pipe and extending the downstream end. This would allow raising the embankment from the downstream toe. Some diking between natural earthen knobs may be necessary. The overflow spillway would likely require serious modification or replacement with a principal/emergency spillway between existing earthen knobs on either side of the dam.

9.4.3 Municipal Water Conservation

A study conducted to determine leakage from municipal water systems in Utah indicates that anywhere from 1 to 15 percent of the water is lost in distribution system leaks. This water loss could be reduced by performing a system water audit and replacing defective pipe sections of the existing distribution system. Further conservation could be achieved by implementing progressive water pricing structures and meters or schedules for both culinary and secondary water service. At present, Monticello is the only city that does not bill for water based on the metered amount delivered. Although meters are in place, only commercial hookups are billed by volume of use. See Section 17 for more information on pricing.

9.4.4 Culinary Water Treatment Plants

Monticello City has recently replaced its water treatment plant (WTP) with a new, larger facility. In addition to the existing supply, the new WTP will draw water from Loyd's Lake as part of a long-term water-service agreement with the San Juan Water Conservancy District. This project was completed in 1999.

The City of Blanding is considering expansion and updating their present water treatment plant and other facilities. They have applied for funding to carry this out in the near future to meet the needs of an expanding population.

A new culinary WTP is being planned for Mexican Hat. The Mexican Hat WTP will divert water from the San Juan River to service residential and commercial water users in this small isolated community. A plan is being explored to allow the Navajo Nation community of Halchita in the Oljato Chapter to purchase water from Mexican Hat. The Halchita treatment plant currently pumps water from the San Juan River at Mexican Hat, treats it, and pumps it to two storage tanks near the town. This system is inefficient, expensive, and frequently shut down while waiting for service from the Navajo Tribal Utility Agency in Kayenta, Arizona. Another possibility is for the town of Halchita to construct a WTP supplied by wells and sell water to the town of Mexican Hat.

9.4.5 Agricultural Water Conversion

There is always the possibility of converting water now used for agricultural purposes to culinary uses. This can be done in two ways. One, if the land is sold for development of residential subdivisions or commercial enterprises, the agricultural water could be used or exchanged to provide culinary supplies. Two, by buying the land along with the water right and converting it for culinary uses. If the land is retired, provisions would need to be made to maintain some kind of cover to prevent flood or wind caused erosion.

9.4.6 Dolores River Project[96]

The Bureau of Reclamation completed the Dolores Project in 1986. The project consists of the McPhee dam and reservoir and related facilities in western Colorado on the Dolores River. Principal use is for irrigation and municipal and industrial water. All of the irrigation water has been allocated. There is currently 5,120 acre-feet of municipal and industrial water that is available for additional users. A meeting between the Dolores Water Conservancy District (DWCD) and the San Juan Water Conservancy District (SJWCD) was held in early 1998. The SJWCD was invited to cost-share in investigations of several agricultural water storage sites. Also, the existing project facilities could be used by SJWCD if and when system capacity were available.

As a result, SJWCD requested Wright Water Engineers, Inc. to investigate constructing a reservoir in Coal Bed Canyon and delivering water to Monticello and Blanding. Two storage capacities were investigated at the Coal Bed Canyon site in Utah; one for 4,000 acre-feet and one for 8,000 acre-feet. There would be 2,000 acre-feet of Dolores Project water and watershed yield above the reservoir depending on the precipitation for any given year, probably less than 2,000 feet on an average year. Another option investigated was delivery of water from Dolores Project facilities near Dove Creek to Monticello and Blanding.[90] No further action has been taken.

9.4.7 Groundwater Development [21,36]

The groundwater aquifers are found at varying depths over large areas of the basin. They include rocks from Cretaceous to Permian age although not all formations are present in all areas. The U.S. Geological Survey grouped these formations into regional aquifer systems in the San Juan County area with each group containing one or more formations. There has also been some grouping of these formations in the Grand County area. In general, the shallower aquifers nearer to the recharge areas contain better quality water. The estimated depth to usable water and aquifers accessible to communities are shown in Table 9-6. These formations and aquifer systems are described in more detail in Section 19. Also, refer to Figure 3-3, Geologic Stratigraphy.

9.4.8 Navajo Indian Reservation Irrigation Projects

There is a need for projects throughout the reservation to help the Navajo Indians improve their quality of life. Irrigation projects will help them provide a more adequate food supply. Water for household use has always been a problem, especially for those who have to haul water for domestic uses.

Irrigation Projects[84] - Two irrigation projects have been investigated by the Natural Resources Conservation Service in Arizona to serve the Navajo Indians. The Montezuma Creek Project was investigated in 1985 and the Aneth Irrigation Project was investigated in 1986.

The Montezuma Creek Project was originally developed in 1936 to irrigate 300 acres of alfalfa, corn and beans in the Montezuma Creek area. In 1985, there were 380 acres being farmed with eight cfs diverted from the San Juan River. The water right was from the upstream Navajo Dam and Reservoir. The water was delivered through an earth channel about 10,000 feet long. It was proposed to convert the project to a pump/sprinkler project at a total cost of $100,000 or $263.16 per acre. About 80 people would benefit. Lack of funding and interest by management have held up the project.

The Aneth Irrigation Project was originally developed in 1905 to irrigate 150 acres of alfalfa, corn and garden vegetables. In 1986, there were 50 acres under cultivation. There was one cfs being delivered through about 9,000 feet of earth ditch. It was estimated it would cost $500,000 or $3,333 per acre to rehabilitate the project. About 80 people would benefit. The

Table 9-6
POTENTIAL COMMUNITY DEVELOPMENT OF GROUNDWATER [21,23,24]

Community/Chapter	Aquifer		Depth (feet)
	System[a]	Formation	
GRAND COUNTY			
Castle Valley		Alluvium	30
	P & C	Cutler formation	150
Grand Water & Swr Ser Ag		Alluvium	
	N	Navajo sandstone	200
SAN JUAN COUNTY			
Aneth	N	Wells in N Aquifer	1,100
Blanding	D	Wells in D Aquifer	200
	M	Wells in M Aquifer	900
	N	Wells in N Aquifer	2,000
Bluff	N	N Aquifer	600
Dennehotso	P & C	Individual wells in P & C Aquifer	NA
Eastland	D	Individual wells-Dakota sandstone	300
	N	Well in Navajo sandstone	1,600
La Sal	N	Well in N Aquifer	800
	M	Well in M Aquifer	600
	D	Well in D Aquifer	300
Mexican Water	N	Wells in N Aquifer	500
Monticello	D	Wells in D Aquifer	NA
Navajo Mountain	P & C	Well in DeChelly sandstone	2,800
Oljato	P & C	Wells in DeChelly sandstone	NA
Red Mesa	N	Wells in N Aquifer	1,000
Teec Nos Pos	M	Wells in M Aquifer	300
	N	Wells in N Aquifer	1,100
Ute Mountain Ute	N	Wells in N Aquifer	1,600
	D or M	Wells in D or M Aquifer	200,700

[a] Hydrogeologic Units
D - Dakota sandstone and Burro Canyon formation
M - Morrison formation
N - Carmel formation, Navajo sandstone, Kayenta formation, Wingate sandstone
P & C - Cutler formation

original diversion on McElmo Creek has been abandoned. Temporary diversions are now being used. Lack of funding and conflicts have held up the project.

Drinking Water Projects[85] - The Navajo Area Indian Health Service has 11 active projects, three of them funded for planning only. These projects vary in total cost from $373,000 to $1,780,500 and will extend and improve the culinary water supply within five chapters. The planning funds are provided to investigate projects in three chapters.

There are also 55 additional drinking water projects proposed. Of these, 27 projects are to extend existing water systems to serve more families and 15 projects are to provide cisterns for areas without any available water. The total water cost for these projects is nearly $22 million and the total project cost including administration is over $26 million. These projects have been given overall scores to prioritize funding. At the current rate of funding under PL 86-121, it will be years before they are funded.

9.4.9 Cloud Seeding

"Seeding" winter storm clouds over the mountains is a well established and understood practice. Clouds form as moist air is lifted and cooled during its passage across mountain ranges. Left to nature, many clouds are highly inefficient precipitators, retaining more than 90 percent of their moisture. By cloud seeding, the precipitation efficiency can be greatly improved. Generally, silver iodide is shot from ground generators to produce artificial ice nuclei that form ice crystals. Spreading the nuclei via aircraft is also common. These crystals attract moisture from the surrounding air forming droplets that grow large enough so they fall to the ground as snow in winter. Some projects using ground-based silver iodide generators to seed winter storms over mountain areas in the western United States have operated continuously since 1950.

Precipitation data from numerous cloud seeding projects have been examined in detail for evidence of downwind effects. Results from these analyses show a slight increase in precipitation in areas up to 90 miles downwind from the project area. No decrease in precipitation has been detected farther downwind from any long-term cloud seeding project.

The first cloud seeding project in Utah began in the early 1950s in the central portion of the state. Cloud seeding started again in 1973 and has continued to the present.

In 1973, the Utah Legislature passed the Utah Cloud Seeding Act. This law provided for licensing cloud seeding operators and permitting cloud seeding projects by the Utah Division of Water Resources. The act states that for water right purposes, all water derived from cloud seeding will be treated as though it falls naturally. The act also allowed for the division to sponsor and/or cost share in cloud seeding projects. Since 1976, the state through the Division and Board of Water Resources has cost shared with local entities for cloud seeding projects.

Cloud seeding projects were operated in San Juan and Grand counties in 1990 and in San Juan County in 1991, 1992 and 1993. The effectiveness of a cloud seeding project cannot be determined without several years of operation because of the wide variability in the weather from year to year.

A long-term project has been operating in central and southern Utah. Statistical analyses of the Central and Southern Utah Project with over 20 years of operation and data indicate a December through March precipitation increase of about 15 percent and an April 1 snow water content increase of about 10 percent. Runoff analysis in Utah indicates a 10 percent increase in April 1 snow-water content will result in a 10 to 20 percent increase in the April-July runoff depending on individual watersheds.

Cloud seeding is most effective when it is continued over several years, providing

increased soil moisture, increased groundwater for springs and keeping up base flows. Seeding only in dry years may not be as effective because of a lack of seedable storm systems.

9.4.10 Water Education

The same amount of water exists today as when earth was first formed. However, demand for water keeps increasing. It has been estimated water usage has tripled since 1950. This makes it imperative to protect the ecological integrity of the natural systems while satisfying the human needs. Populations must balance their need to use water with their responsibility for its quality and availability. These and other issues will continue to confront us into the 21st century. Finding the answers depends on a populace sensitive to and knowledgeable about water and related resources. Education provides one of the best approaches to ensuring responsible behavior toward water.

Water Education Poster contest - 1999

Project WET (Water Education for Teachers), through its education services and programs, will help prepare students for citizenship through this century. The goal of Project WET is to facilitate and promote awareness, appreciation, knowledge and stewardship of water resources. Project WET is an internationally sponsored program that disseminates classroom-ready materials to help students develop the skills necessary to make informed decisions regarding water resources management.

The annual Young Artists' Water Education Poster contest is an event which continues to be the highlight of every October, Water Education Month. Children in kindergarten through 6th grade participate in this district/statewide contest each year. Themes chosen relate to water as a resource. The poster contest provides schools the opportunity to teach students about water awareness and wise water use.

Project WET is sponsored in Utah by the Division of Water Resources. A state coordinator supervises the training of public and private school teachers in a workshop setting where innovative water related, hands-on, and fun activities prepare them for classroom successes. Water fairs are conducted in individual schools where classes are taught by teachers trained in Project WET workshops and by trained local water professionals. Water experts are also available for individual classroom presentations on a variety of water related topics. Water-related resources materials (such as booklets, brochures and videos) are also available to spread the water message.

Water education also includes promoting the numerous programs available for water conservation. These include installing low water-using fixtures such as low-flow toilets and shower heads, using secondary irrigation water systems, and implementing conservation inducing price-rate structures. These programs are explained in more detail in Section 17.

9.5 WATER PLANNING ISSUES

Concerns have been raised about meeting future water demands. There is always the desire to develop more irrigation water, especially in the Monticello and Blanding areas. However, this is not feasible on its own merits at present. Also, meeting the culinary water demand is becoming an increasing problem, especially in the Spanish Valley/Moab area and in the communities of Blanding, Castle Valley and Mexican Hat. Although some progress has been made, there is much to be done.

The Southeast Colorado River Basin includes the Navajo Indian Reservation and Ute Mountain Ute tribal lands within its borders. Both entities fall under the administrative jurisdiction of the Bureau of Indian Affairs (BIA). The Indian population within these reservations experience water shortages and water quality issues similar to or greater than the non-Indian areas.

An effort should be made by both state and federal water agencies through tribal authorities and the BIA to coordinate the planning and development of the overall water supplies within the boundaries of impacted entities. Historically, water planning efforts have been done on an independent basis with little or no cooperation between Indian and non-Indian water agencies. As the water supplies in the San Juan River Basin become stressed, the issue of developing a coordinated water plan needs to be addressed. Navajo and Ute Indian water needs are an integral part of the San Juan County Water Master Plan. This is a step in the coordination process. ❑